

DESIGNATION OF INVENTORS

FIRST INVENTOR:

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PRIORITY: German No. 102 36 502.4  
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TITLE: SEALABLE FILM FOR TEAR-OPEN PACKAGING

UNITED STATES SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, RALF NIEPELT, a German citizen,  
residing at Sparenberg Strasse 29, D-48599 Gronau, Germany,  
have invented certain new and useful improvements in a

SEALABLE FILM FOR TEAR-OPEN PACKAGING

of which the following is a specification.

## BACKGROUND OF THE INVENTION

### CROSS REFERENCE TO RELATED APPLICATIONS

Applicant claims priority under 35 U.S.C. §119 of German Application No. 102 36 502.4 filed August 9, 2002.

#### 1. Field Of The invention

The present invention relates to the use of a sealable film for the production of tear-open packaging.

#### 2. The Prior Art

Conventional blown films or flat films have very different mechanical properties in the lengthwise and the crosswise direction. While films made of polypropylene preferably tear in the machine running direction, tears in polystyrene films preferably propagate themselves crosswise to the machine running direction. The anisotropic mechanical properties are a disadvantage when these films are used as film packaging. When a film package is opened, there is the particular problem that the film package tears open in an uncontrolled manner.

Furthermore, cycloolefin copolymers are known as film materials (Verpackungs-Rundschau 9/18, pages 52 to 54). The raw material basis for cycloolefin copolymers is ethylene and

dicyclopentadiene, from which the comonomer norbornene is obtained. Cycloolefin copolymers, abbreviated as COC, are produced from norbornene by solvent polymerization with ethylene, using metallocene catalysts. Cycloolefin copolymers are amorphous, relatively rigid and brittle, highly transparent plastics, the glass transition temperature of which can be modified by means of the installation ratio of ethylene and norbornene. Because of the brittle character of the polymers, the films possess a low tendency to tear and tend to break if they are bent severely. The mechanical properties of these materials can be modified by mixing them with polyolefins.

Deep-drawable laminate films, which have a layer of cycloolefin copolymer and at least one layer made from a polyolefin, are known from EP 1 213 138 A1. The connection between the COC layer and the polyolefin layer is produced by means of an adhesion agent, e.g. on the basis of a linear polyethylene.

### SUMMARY OF THE INVENTION

The object of the invention is to provide a sealable film for the production of tear-open packaging, which does not tear open in an uncontrolled manner when the packaging is opened.

These and other objects are achieved in accordance with the invention by the use of a sealable film for the production of tear-open packages that demonstrate balanced tear start and tear propagation properties in the crosswise and lengthwise direction of the film. The film, which may be a monofilm or single layer film in total, or a multi-layer laminate film produced by means of coextrusion, has at least one layer of a polymer mixture of a cycloolefin copolymer (COC) and polyolefin or an ethylene copolymer. The COC portion in the polymer mixture is 20 to 80 wt.-%, the remainder polyolefin or ethylene copolymer.

Preferably, an ethylene/norbornene copolymer produced using metallocene catalysts is used as the cycloolefin copolymer. Mixing of the cycloolefin copolymer preferably takes place with a low-density polyethylene having a linear structure, particularly linear low-density polyethylene (LLDPE) or very low-density polyethylene (VLDPE).

Furthermore, ethylene copolymers, e.g. ethylene/vinyl acetate copolymer (EVA), ethylene/butyl acrylate copolymer (EBA), ethylene/acrylic acid copolymer, (EAA) and the like are suitable for mixing. For tear-open packaging that is exposed to higher temperatures, polypropylene is preferably used for mixing with COC.

According to the invention, advantage is taken of the fact that a film which, as a monofilm, in total, or as a multi-layer laminate film, produced by means of coextrusion, contains at least in one layer a polymer mixture of COC and a polyolefin, demonstrates balanced mechanical properties in the lengthwise and crosswise direction of the film, and particularly possesses balanced tear start and tear propagation properties. A tear that occurs when the film is torn open propagates in a straight line, in each instance, both in the lengthwise direction of the film and the crosswise direction of the film. Packaging produced from this material, e.g. in the form of bags, can therefore be opened without having the packaging tear in an uncontrolled manner. Perforations or tear notches are not necessary. In addition, the film has good rigidity and therefore punchability and cuttability, and is easy to seal if the proportion of polyolefin is sufficient.

According to a preferred embodiment of the invention, sealable laminate films that have at least three layers are used to produce tear-open packaging. The laminate film can have a core layer made from a polyolefin and layers adjacent to the core layer on both sides made from polymer mixtures of cycloolefin copolymers and polyolefins. One outside layer may contain a polyolefin, as a sealing layer, and the other outside layer may be formed from a cycloolefin copolymer or a polymer mixture having a high cycloolefin copolymer proportion. For the intermediate layers, polymer mixtures of cycloolefin copolymers and polyolefins may be used that have a polyolefin content between the values in the outside layers. The polyolefin content changes, step by step, from a high value at the sealing layer to a low value at the opposite layer, the properties of which are marked by the high COC proportion. According to a particularly preferred embodiment of the invention, the film possesses a three-layer structure, whereby the thickness of the core layer, which is a polyolefin or a polymer mixture with a high polyolefin content, is a multiple of the thickness of the two outside layers.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The film that is used to produce tear-open packaging in accordance with the invention has a thickness of at least 15  $\mu\text{m}$  and can be produced by means of a flat film extrusion process or an extrusion blowing process. The film can be further finished by means of lamination, imprinting, or coating, e.g. with aluminum coatings, before being processed further.

### Exemplary Embodiments

The following exemplary embodiments relate to three-layer laminate films produced by means of coextrusion, having a symmetrical layer structure A-B-A or an asymmetrical layer structure A-B-C.

#### Example 1:

The laminate film has a total thickness of 70  $\mu\text{m}$  and has a symmetrical layer structure A-B-A with

Layer A: 10  $\mu\text{m}$

80 wt.-% cycloolefin copolymer

20 wt.-% polyethylene LLDPE C8

Layer B: 50  $\mu\text{m}$

100 wt.-% polyethylene LLDPE C8

Example 2:

The laminate film has a total thickness of 50  $\mu\text{m}$  and has a symmetrical layer structure A-B-A with

Layer A: 7  $\mu\text{m}$

80 wt.-% cycloolefin copolymer

20 wt.-% polyethylene LLDPE C8

Layer B: 36  $\mu\text{m}$

100 wt.-% polyethylene LLDPE C8

Example 3:

The laminate film has a total thickness of 50  $\mu\text{m}$  and has an asymmetrical layer structure A-B-C with

Layer A: 7  $\mu\text{m}$

80 wt.-% cycloolefin copolymer

20 wt.-% polyethylene LLDPE C8

Layer B: 36  $\mu\text{m}$

20 wt.-% cycloolefin copolymer

80 wt.-% polyethylene LLDPE C8

Layer C: 7  $\mu\text{m}$

100 wt.-% polyethylene LLDPE Ci

The films according to the exemplary embodiments possess balanced mechanical properties in the lengthwise and crosswise direction, particularly balanced tear start and tear propagation properties. The following mechanical properties were measured in the machine direction, i.e. lengthwise direction MD, and the crosswise direction CD:

		Example 1	Example 2	Example 3
Tear propagation properties according to Elmendorf ISO 6383-2	MD mN	1000-1400	400 - 600	250 - 450
	CD mN	1000-1400	400 - 600	250 - 450
Strengths DIN 53455	MD N/inch	40 - 50	25 - 35	23 - 33
	CD N/inch	40 - 50	25 - 35	23 - 33
Modulus of elasticity DIN 53455	MD N/mm <sup>2</sup>	500 - 600	500 - 600	450 - 550
	CD N/mm <sup>2</sup>	450 - 550	500 - 600	450 - 550
Stretching DIN 53455	MD %	400 - 600	300 - 500	150 - 350
	CD %	400 - 600	300 - 500	150 - 350
Yield stress DIN 53455	MD N/inch	30 - 40	20 - 30	15 - 25
	CD N/inch	30 - 40	20 - 30	15 - 25

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Strengths at X% stretching	3% MD N/inch	22 - 32	18 - 8	15 - 25
DIN 53455	5% MD N/inch	28 - 38	22 - 32	15 - 25
	10% MD N/inch	30 - 40	25 - 35	16 - 26
	3% CD N/inch	22 - 32	18 - 28	13 - 23
	5% CD N/inch	28 - 38	22 - 32	15 - 25
	10% CD N/inch	30 - 40	25 - 35	16 - 26

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It was possible to produce packaging bags that were easy to open and demonstrated balanced tear start and tear propagation properties in the lengthwise and crosswise direction from all the films.

While only a few embodiments of the present invention have been shown and described, it is to be understood that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention as defined in the appended claims.